Renewable and Sustainable Energy Reviews 15 (2011) 4302–4309

Contents lists available at SciVerse ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

The mechanism and policy on the electricity price of renewable energy in China

Zhao Xingang*, Liu Xiaomeng, Liu Pingkuo, Feng Tiantian

School of Economics and Management, North China Electric Power University, Beijing 102206, China

ARTICLE INFO

Article history:
Received 15 April 2011
Accepted 5 July 2011
Available online 1 October 2011

Keywords:
Renewable energy
Electricity price
Policy mechanism

ABSTRACT

With the rapid development of the society, energy demand is becoming more urgent. So it is necessary to exploit the renewable energy because of the limited conventional energy. This paper introduced the current development situation of the renewable energy, analyzed the subsidy policy and discussed the problems of the electricity price mechanisms and policies in China. Finally we got the conclusion that government should formulate more policies to encourage private and foreign enterprises to invest renewable energy industries as well as to apply the CDM mechanism.

Contents

* Corresponding author.
E-mail address: rainman319@sina.com (Z. Xingang).

1364-0321/$ – see front matter
doi:10.1016/j.rser.2011.07.120

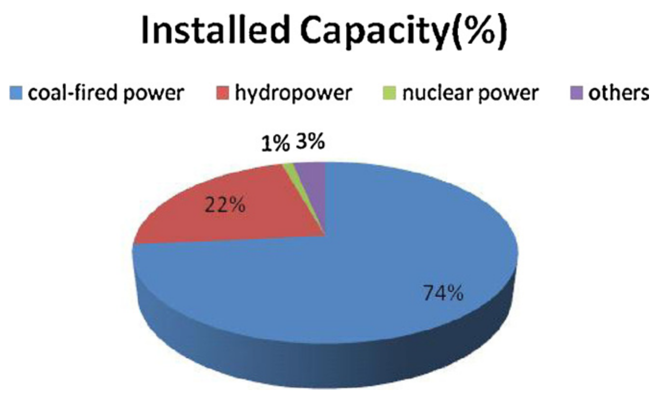


Fig. 1. Distribution of the installed capacity in China.

1. Introduction

Entering the 21st century, the fast economic growth leads to the urgent need and huge consumption of energy resources. While the limit of fossil energy and its rising price make government begin to emphasize on and encourage the exploit and use of renewable energy. In recent years, the development of renewable energy has achieved a great progress substantially, especially the implementation of the People's Republic of China on Renewable Energy Resources Law on 1st Jan 2006, which made the development of renewable energy in China become having the laws to abide by.

By the end of 2010, the total installed capacity in China is 0.926 billion kW, which has increased by 10.07% compared to 2009 and it increases 13.33% averagely in recent 5 years. Among them, 706.63 million kW comes from coal-fired power, 213.4 million kW comes from hydropower, 10.82 million comes from nuclear power, and wind and other kind of power generation contribute the rest (Fig. 1).

As to each kind of power generation, the installed capacity of hydropower ranks first all over the world and will reach 0.3 billion kW in 2015; the installed capacity of wind power ranks second accounting for 16% in the world; and the installed capacity of photovoltaic will reach 1 million kW (Table 1).

2. Principles and methods

2.1. Principles

The reasonable and effective price is the basic measure for the market to allocate resources, and it is also the institutional foundation of maintaining the operation order of the market economy. On the one hand, because of the existence to the externality, neither does the economic actor bear the external cost nor gain the external benefit, which lead to the market failure and the inefficient allocation of energy resources. To solve this problem, the economist Arthur Cecil Pigou proposed the theory that social costs could be internalized through the government intervention such as taxation on the contamination in 1920. On the other hand, the price of the natural resources as the scarce element in China is much lower than that of the international standard. Therefore, the formulation of the electricity price for renewable energy must embody the scarcity of resources. The following will show the price effects.

Table 1
Applied scope and aim for the renewable energy in China.

Types	Capacity in 2007	Target of 2020
Hydropower	145 GW	300 GW
PV	100 MW	1.8 GW
Wind power	6 GW	30 GW
Solar water heater	130 m^2	300 m^2
Biomass	3 GW	30 GW
Biogas	99 m^3	440 m^3
Bio-solid fuel	–	50 million tons
Fuel ethanol	1600 million liter	12,700 million liter
Biodiesel	119 million liter	2400 million liter
Terrestrial heat (power generation and supply)	32 MW	1200 tce
Tidal energy	–	100 MW

From: CCID Consulting 2010.02.

2.2. Supporting the generation of renewable energy

The development of renewable energy commences relatively late, having the characters of intermittence and discontinuousness which makes the power generation quality of renewable energy has not as well as that of conventional energy. According to the data published by National Development and Reform Commission, the cost of biomass generation is slightly lower than that of wind power generation whose cost is about 0.48 RMB per kWh, but it is still higher than that of the coal-fired power generation; the cost of solar photovoltaic is about 3–6 RMB per kWh. If it is only the market that plays the leading action without the government intervention, renewable energy will be inevitably excluded because of the high cost of generation resulting in the lack of the competition advantage, which makes the price mechanism cannot play the role, and then the market failure appears. The external costs of renewable energy are much lower compared to that of fossil fuel energy, hence to ensure the development of renewable energy, which is necessary to establish the supportive policy to the electricity price for renewable energy through the government intervention.

2.3. Embodying the externality of renewable energy

At present, the external cost is not reasonably reflected by the energy price mechanism in China. The numerous SO_2, CO_2 and the NO emitted from the coal-fired power plants not only have negative influence on agricultural production, buildings and people's life and health, but also lead to the huge loss of public utilities, having the negative externality [3]. While renewable energy generation which has the external economy brings little pollution to the environment as well as solve the present problem of energy shortage, which means the private benefit gaining from the activities of renewable energy generation is less than the social benefit brought by these activities. Therefore, the policy formulation of electricity price for renewable energy generation should be able to reflect the external electricity price mechanism so as to assist the development of the external renewable energy power industry [2].

2.4. Methods

At the moment, there are four price systems of electricity for renewable energy in the world, which are fixed price system, bidding and tendering pricing system, quotas system and green electricity price system.

In China, the electricity price of wind power generation is guided by the government in accordance with "*Interim Management Measures for Renewable Power Tariff and Cost Allocation*", and the detailed criterion is defined by the price administrative department in State Council according to the formulated price in bidding. Electricity price for biomass energy will be set by government that is the price administrative department in State Council formulates the benchmark electricity price according to the different area. The electricity price consists of the benchmark electricity price of the desulfurized coal-fired power plant in 2005 and the subsidy price

Table 2
Overall situation of subsidy.

	Installed capacity (MW)	Electricity capacity of grid feed-in (MkWh)	Subsidied project number
Jan. to Dec. 2006	1414.3	1043.789926	38
Jan. to Sep. 2007	2963.5	2799.2946	76
Oct.2007 to Jun. 2008	5697.162	7721.253388	149
Jul. to Dec. 2008	8953.07	8443.757889	224
Jan. to Jun. 2009	11979.27	13764.62	281
Jul. to Dec. 2009	16904.31	16718.8701	382

From: Website of National Development and Reform Commission.

of 0.25 RMB per kWh. The power plant will gain the subsidy price for 15 years since it is put into operation; and the subsidy price will be cancelled once the operation time exceeds the 15 years. From 2010, subsidy price for newly approved generation projects will be 2% than that of the year before.

The mixed fuel generation project which the conventional energy in the consuming quantity of heat is over 20% will be defined as the conventional generation project adopting the benchmark electricity price of local coal-fired power plant without the subsidy price.

Electricity price for biomass project by bidding to define the investor will be guided by the government. That is it will adopt the award of tendering price, but this price is not allowed to be higher than the local benchmark electricity price. Government will formulate the price for power generation projects of solar, ocean energy and terrestrial heat, and the pricing standard is set by the price administrative department in State Council due to the principle of reasonable cost plus reasonable profit.

The price adding part of electricity price for power generation projects of renewable energy higher than the benchmark electricity price for local desulfurized coal-fired units, the price adding part of the expense of operation and maintenance for independent electric power system on public renewable energy projects constructed by the country's investment or subsidy higher than the average sales electricity price of electric grid in local provincial level and the grid feed-in expenses for power generation projects of renewable energy, will be transferred to the customer by levying the additional electricity price [12].

Calculation formulas for renewable energy electricity price are:

Additional electricity price of renewable energy = total amount of additional electricity price of renewable energy/total amount of additional electricity price of renewable energy of whole country's sales quantity of electricity in adding price = Σ ((the electricity generation price of renewable energy − the benchmark electricity price of the desulfurized coal-fired units of the electric grid in local provincial level) × the quantity of electricity of renewable energy purchased by electric grid + (the expense of operation and maintenance for independent electric power system on public renewable energy projects − the average sales price of the electric grid in local provincial level × the sales quantity of electricity for independent electric power system on public renewable energy projects) + the electric grid feed-in expenses and the other reasonable fees of power generation projects of renewable energy.)

Among the above:

(1) The whole country's sales quantity of electricity in adding price = total amount of electricity saled by electric grids in and above provincial level in the planning period–the quantity of electricity consumed by agriculture production–the sales quantity of electricity in Tibet.
(2) The quantity of electricity of renewable energy purchased by electric grid = the planned quantity of power generation of renewable energy − the quantity of auxiliary power.
(3) The expense of operation and maintenance for independent electric power system on public renewable energy projects = the operational cost for independent electric power system on public renewable energy projects × (1 + value added tax rate).
(4) The electric grid feed-in expenses and the other reasonable fees of power generation projects of renewable energy means the expenses of the project investment and operation and maintenance specifically used for the electric grid feed-in of the power generation projects of renewable energy, which based on the design documents approved by the related departments in government.

The electric grid feed-in expense is included in the additional electricity price of renewable energy before the cost of electricity transmission and distribution is not be explicitly defined by State.

3. Current subsidy situation and subsidy policy of renewable energy power generation

According to the Subsidies for "Notice on Scheme for Renewable Power Tariff Subsidies and Quota Trading" which has been released six times, although the hydropower is regarded as the renewable energy, its generation cost is the lowest among all the generation methods, so there is no subsidy for it.

3.1. Overall situation

By the end of 2009, National Development and Reform Commission and State Electricity Regulatory Commission have jointly issued six additional tariff subsidies and deployment programs as followed (Table 2 and Fig. 2):

The number of subsidized projects, the installed capacity and electricity capacity of grid feed-in in 2009 are almost 10 times compared to that of 2006. The trends of subsidized projects' number and electricity capacity of grid feed-in are similar. Thus, the development of renewable energy is very rapidly.

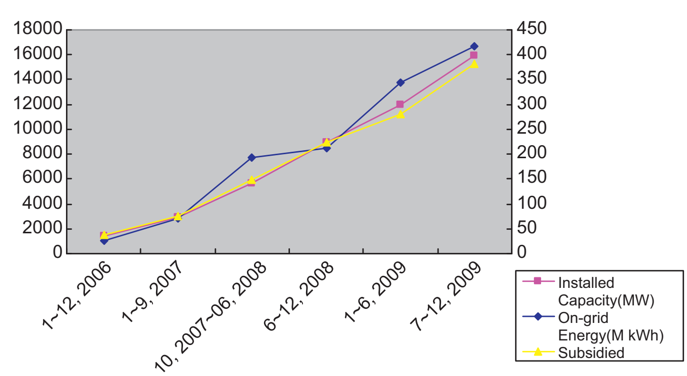


Fig. 2. Overall situation of subsidies.

Table 3
In the second half of 2009, the specific circumstances of various types of renewable energy.

	Installed capacity (MW)	Electricity capacity of grid feed-in (M kWh)	Amount of subsidy (Million RMB)	Subsidied project number
Wind power	14596.25	13992.29	3043.462	286
Biomass	1384.412	2845.235	606.9429	90
Solar power	7.771	3.3314742	9.081649	7

From: Website of National Development and Reform Commission.

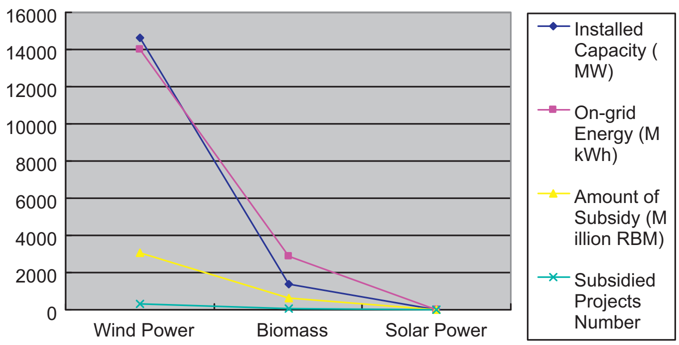


Fig. 3. In the second half of 2009, the specific circumstances of various types of renewable energy.

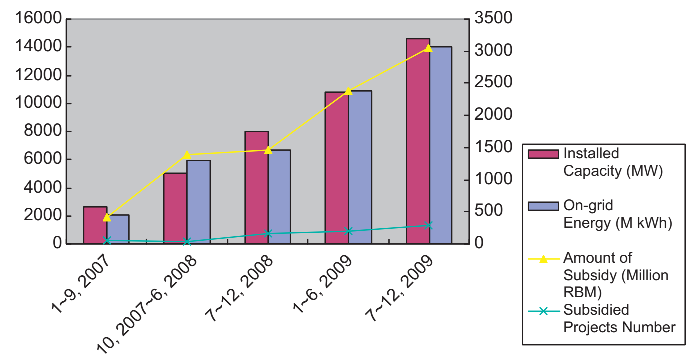


Fig. 4. The trend for wind power generation subsidy.

3.2. Development situation of various types

From the above charts, wind power generation developed in the quickest speed. In 2009, the total installed capacity of all wind power projects accounted for 91.78% of all renewable energy power generation projects which had received the subsidies. The next is the biomass power generation. As for the solar photovoltaic generation, due to the limitation of technology and capital, the current development grows slowly, being in the experimental stage now (Table 3 and Fig. 3).

3.2.1. Wind power generation

The number of subsidized projects is increased by 229 in 2009 compared with 2007, which is 4 times more than that of 2007. And the installed capacity is 4.5 times more than that of 2007 (Table 4 and Fig. 4).

3.2.2. Biomass power generation

Although in the second half of 2008, the electricity capacity of grid feed-in and amount of subsidies have decreased compared to the previous period, it still developed steadily. The development of biomass power generation is not in large scale compared to wind power generation. On one hand, the application of biomass is closely related to the agriculture. Although China is a large agricultural country, the level of mechanization is very low, and the most of crop waste has not been applied in an environmental method [1]. On the other hand, the supply of biomass raw material does not exist continuously. For better development of biomass power generation, technology should be improved and the farmers' consciousness for utilizing agricultural wastes should be strengthened more (Table 5 and Fig. 5).

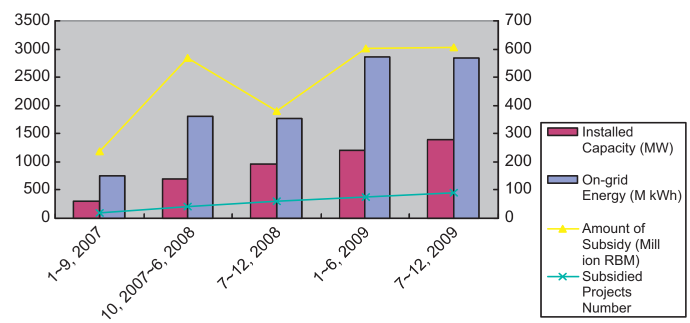


Fig. 5. The trend for biomass power generation subsidy.

3.3. Solar photovoltaic

The number of subsidized projects in first half of 2009 is just one less than that of 2008, leading to the decrease of subsidy amount and electricity capacity of grid feed-in. But in the second half of 2009, the number has increased to six, and solar photovoltaic developed fast (Table 6 and Fig. 6).

3.4. Renewable energy development in different regions

From a regional perspective, the number of provinces which develop renewable energy has surged to 37 compared with 2006, almost throughout the whole country. The fast development of wind power is in western area, such as west and east Inner Mongolia, Ningxia and Xinjiang. Biomass power developed well in the large agricultural provinces such as Heilongjiang, Shandong, Henan and Jiangsu. As for solar photovoltaic, it developed well not

Table 4
Subsidy for wind power generation.

	Installed capacity (MW)	Electricity capacity of grid feed-in (M kWh)	Amount of subsidy (Million RMB)	Subsidied project number
1–9, 2007	2653.95	2049.141796	422.683091	57
10, 2007–6, 2008	4999.6	5915.9344	1381.8919	43
7–12, 2008	7988.6	6667.651487	1469.585935	161
1–6, 2009	10769.1	10896.85	2387.5603	202
7–12, 2009	14596.25	13992.29	3,043.462	286

From: Website of National development and reform commission.

Table 5
Subsidy for biomass power generation.

	Installed capacity (MW)	Electricity capacity of grid feed-in (M kWh)	Amount of subsidy (Million RMB)	Subsidied project number
1–9, 2007	309.5	750.152784	237.434117	20
10, 2007–6, 2008	696.206	1804.24217	568.67874	43
7–12, 2008	958.21	1775.228	379.8846	60
1–6, 2009	1208.81	2867	602.5557	77
7–12, 2009	1384.412	2845.235	606.9429	90

From: Website of National Development and Reform Commission.

Table 6
Subsidy for solar power generation.

	Installed capacity (MW)	Electricity capacity of grid feed-in (M kWh)	Amount of subsidy (Million RMB)	Subsidied project number
10, 2007–6, 2008	348.9444	107.6774	1.356	3
7–12, 2008	233.261	65.324	1.26	2
1–6, 2009	253.9721	77	1.36	3
7–12, 2009	908.1649	331.4742	7.771	6

From: Website of National Development and Reform Commission.

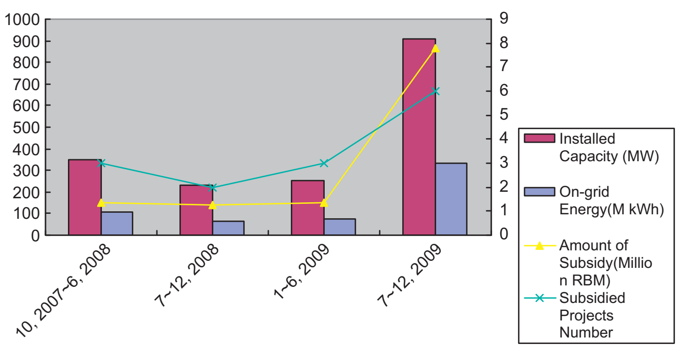


Fig. 6. The trend for solar power generation subsidy.

only in economy developed areas where can get subsidy much, such as Shanghai; but also developed well in strong solar radiation areas such as Ningxia and the Tibet.

3.5. Amount of subsidies

Subsidy programs aim at the price adding part of electricity price for power generation projects of renewable energy higher than the benchmark electricity price for local desulfurized coal-fired units, and the amount of subsidy shows the changing situation of the development of renewable energy (Table 7 and Fig. 7).

Although the amount of renewable energy subsidies increased by 14.5 times, the growth rate of the overall amount of subsidies is still slow.

Table 7
Amount of subsidies.

	Amount of subsidy (Hundred Million)	Growth rate
Jan. to Dec. 2006	2.51	1.63
Jan. to Sep. 2007	6.6	1.96
Oct.2007 to Jun. 2008	19.54	−0.05
Jul. to Dec. 2008	18.52	0.62
Jan. to Jun. 2009	29.93	0.21
Jul. to Dec. 2009	36.31	

From: Website of National Development and Reform Commission.

4. Problems of price mechanism and policy

4.1. Problems of price mechanism for renewable energy

4.1.1. Wind power

The good-quality resource has not been encouraged to be exploited because the confirmation of electricity price of feed-in of wind power is determined by bidding prices. According to "Renewable Energy Law" Article XIX, the electricity price of feed-in of renewable energy power generation projects which are carried out by bid should be followed out according to the award price. While there is no cap price for wind power and the over part compared to that of conventional energy should be apportioned nation widely, and the award of electricity price of feed-in is higher than that of nation's average price which is driven by the benefit of local government. In reality, there is a phenomenon that low price and high price exist at the same time. For instance, the award price of project named Huitengxile in Inner Mongolia is just 0.382 RMB/kW, while the price is 0.887 RMB/kW for the project named Qiyueshan wind power in Lichuan city of Hubei province. Good-quality wind resource will not be encouraged to be exploited by the extremely high and imbalance award price. In addition, since the electricity price is bided and approved in accordance with every single project, there is no definite signal for investment to exploit the wind resource, which results to the investments for wind power from foreign and private enterprises will be inevitably affected. And it will lead to the situation of monopoly which means the wind power will be exploited only by state-owned companies and large-scale energy companies.

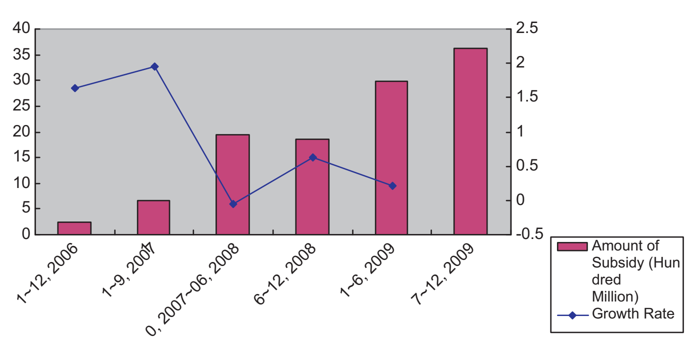


Fig. 7. The growth rate of the amount of subsidies.

4.1.2. Biomass power

On one hand, the same electricity price of feed-in cannot embody the different cost of the varying kinds of biomass energy. There are many kinds of biomass energy generation such as straw-direct combustion power generation, straw-gasified power generation, bagasse power generation, forest wood-direct combustion power generation, forest wood-gasified power generation, waste incineration generation, landfill-gasified power generation, biogas power generation and others. Due to the varying requirement of each power generation such as type of resources, technical route and environmental standard, there are some differences in the cost of power generation, for instance, the cost of waste incineration generation is 0.1 RMB higher per kWh than that of landfill gasified power generation.

On the other hand, according to the rules, co-combustion power generation projects are not subsidized with fuel price if the proportion of conventional energy exceeds 20% of the whole energy consumption, which will not encourage the existing coal-fired units to transform into the units burned with biomass energy resource. With characteristics of dispersed production, seasonal dependence, short harvest period etc., the supply of biomass fuel does not meet the requirements such as centralized power generation, in scale and durative. Meanwhile, the value of biomass fuel is very low and its volume density is small as well as low output of per unit area, which leads to high storage cost. If coal-fired power plants burn with biomass energy without price subsidy, they will lose the transformation motivation.

4.1.3. Photovoltaic power generation

The current policies of China do not provide the enough support for the development of photovoltaic market and the whole industry. Although the development of solar photovoltaic technique has become mature, the price is still too high to be afforded by the national economy. The price for solar photovoltaic now is determined by government on the basis of the principle which are the cost with the reasonable profits. Therefore, the two major problems which are how to reduce the solar photovoltaic cost and how to maintain the measurable development scale will be solved in future.

4.1.4. High cost of supervision

The supervision cost of current distribution method of renewable energy's power price addition very high for government to afford. So far, a series of governmental funds and addition such as the Three Gorges Project Construction Fund, the rural loan fund to support post-migration, urban public utilities fund and others have been imposed through power tariff, and a fairly standard approach of collection, use and management has been formed. It is the most efficient and the minimum supervision cost solution to classify renewable energy power price addition into governmental fund, which is imposed and used by Finance Ministry [5,6]. While because of the disagreement of the Ministry of Finance, the charged power price addition is distributed among power grid enterprises through quota trading. This will bring a series of financial and taxation problems and increase the governmental supervision cost.

4.1.5. Imperfectness of the mechanism of levy and distribution

The current distribution approach is "the horizontal management of funds", and it is distributed according to the quotation issued by government. The imposed funds and subsides from renewable energy electricity price addition can be distributed among the enterprises of provincial electric power grid. In fact, the double taxation will appear when one grid enterprise has paid the tax for the overall price addition and then the part of price addition has been transferred to other provincial enterprises where need it, also there is no special fund in finance to distribute the money. Therefore, the above issues will lead to the high cost of supervision with the low efficiency.

4.2. Main problems of renewable energy power price policy

The industrial policy system of China's renewable energy still needs to be improved. A few years ago, China published a series of policies and laws such as "Renewable Energy Law", "Long-term Plan for Renewable Energy" etc. in order to promote the industrial development of renewable energy. However, there has not law or regulation aiming at electricity price and the speed of market expansion is slow [7]. Also at present, there is no clear provision for coordination mechanism of project approval, special funds, pricing mechanism etc. The subsidies of central and local government lead to the rapid increase of short-term investment behavior which will become the obstacle to the development of renewable energy industry.

Electricity price of grid feed-in: (1) For electricity price of grid feed-in of wind power, there are two problems. One is there is no efficient price mechanism to promote the enterprises to reduce their cost and innovate the technology, while the second is there is no mechanism focusing on offshore wind electricity price and the regulations for offshore wind development to avoid blind expansion and unplanned development. (2) For electricity price of grid feed-in of solar power, one problem is the benchmark electricity price previously announced to the public is not yet implemented. Currently, the electricity price of solar power generation is fixed by bid price or according to the project's cost, and the policy is not transparent. The second problem is the cost of solar power generation is still very high due to the characters of technology, scale, market and other issues. If the price is fixed low, the generation enterprises cannot maintain and develop; while if the price is fixed high, the suspect whether it is economical may bring forward blind investment and even low-level redundant construction. (3) The main problem of biomass power generation is low electricity price and non-standard management. Because the installed capacity of biomass power generator is small and the quantity of the fuel is huge, the investment per unit is vast and the cost of the fuel is high. The current operating conditions of biomass power generation enterprises show that there is still a big gap between the price approved by government and the guaranteed price. And current electricity price of grid feed-in can hardly maintain the enterprises' reproduction, so most of the biomass power generation enterprises are in a situation of deficit [8]. Although the National Development and Reform Commission has formulated the temporary subsidies policy of 0.1 RMB/kWh for straw power project, it is still difficult to reverse the loss situation of biomass power generation enterprises. In addition, it is not helpful to establish price standard management by using the temporary price subsidy.

Grid connection cost: First, the subsidy for grid connection is low. The current subsidy of 1 to 3 cents per kWh for grid connection engineering of renewable energy power generation projects is too low to meet the requirement of repaying capital with interest for the investment of grid connection engineering project. Second, the subsidy policy for electricity price of grid feed-in is not reasonable. The existent policy only considers the local network access cost, and ignores transmission of the long-distance and grid expansion for the areas of sending and receiving, where are mainly in the "Three North Area" and the other remote, underdeveloped economic areas. The costs of construction and operation for grid supporting projects of renewable energy are higher than that of conventional energy. If the cost recovery is withdrawn by local sales price, it will increase the burden on users; while if it is withdrawn by the electricity price of grid feed-in, it will significantly decrease the competiveness of renewable energy power generation. Both

methods are not beneficial for the exploitation and the utilization of renewable energy.

5. Conclusion and suggestions

From the above analysis, the markets of renewable energy for wind power, biomass power or photovoltaic are mostly exploited by the state-owned companies because of high industry barrier. Whereas, the private enterprises are the main driving forces of the development of renewable energy in China. According to Renewable Energy Law, foreign and private capitals are encouraged to enter renewable energy industry, and promote the development of industry and market. The renewable energy industry will be developed rapidly and influenced by the encouraging policy.

The formation of mechanism for electricity price of renewable energy should be in conformity to the following four principles: facilitate the development, improve the efficiency, reduce the cost and encourage the competition. When operating in reality, the rules should be obeyed as followed:

Principles	
1	Ensure the realization of renewable energy strategy target
2	Promote the technology improvement of renewable energy power generation
3	Consider the practical situation and the level of economy development at different stages of current and future in China
4	Be beneficial to the reasonable layout of renewable energy power generation
5	Be easy to handle the price policy

5.1. Short, medium and long term selection for price policy of renewable energy

It is defined that short-term is from 2011 to 2015, medium-term is from 2016 to 2020, and long-term is after 2020.

As for wind power generation, it has developed in scale due to the mature technology (fans of 1500 kW have been produced at present). The cost of wind power generation is not twice than that of coal-fired generation, and it may be equal to the cost of coal-fired generation added with external benefits.

Policy choice on electricity price of wind power	
Short-term	According to the actual information of wind energy resources, price policy should be based on fixed price, assisted with bidding price. And mandatory grid feed-in policy should be made to ensure investors' reasonable benefit and regulate the market in order to achieve the rapid development of wind power.
Medium-term	Introduce the system of electricity price of grid feed-in through bidding in some appropriate areas, and government provides the appropriate standard of price subsidies according to the external benefits.
Long-term	The wind power has the ability to compete with the coal-fired power from the economic. Therefore, the economic policy such as the price will not become the main supporting point. The government's support for wind power will be mainly embodied on grid construction, improving the level of grid dispatching, and energy storage technologies etc. At the same time, the barriers for grid integration of wind power should be eliminated in order to ensure wind power become more competitive in market.

As for biomass power generation, its technology is diverse and mature, and the cost and electricity price of power generation are closely related to the cost of raw materials which are affected by that of conventional energy such as coal. So, there is a little room to reduce to its cost.

Policy choices on electricity price of biomass power	
Short-term	The policy of fixed-price should be adopted due to the different price level of varying techniques, and also the mandatory policy of grid feed-in should be executed to ensure the investment of biomass energy. At the same time, we should consider the external value of power production and the related price situation between coal and raw material of biomass power generation so as to make the different electricity price of varying kind of biomass power generation.
Medium-term	Introduce the price policy of grid feed-in through bidding in some appropriate areas, and formulates the appropriate standard of price subsidies according to the external benefits.
Long-term	After 2020, we will decide whether to use subsidy or not according to the comparison result of the real cost and the utilization economy of biomass power generation and coal-fired power generation.

As for solar power generation, the technique of solar photovoltaic is mature and there are the potential of enormous resource and the space of cost reduction in future. While the trend of technology development is uncertain and the space of cost reduction is unclear, leading to the price of solar photothermal power generation is too high to be accepted by enterprises and the public.

Policy choices on electricity price of solar power generation	
Short-term	Government should formulate the reasonable standard of electricity price or electricity price subsidy, develop the bid for demonstration project and control the development scale by using several methods in order to ensure the high return on investment of solar power generation project, and at the same time modify the price standard in accordance with the situation of cost change.
Medium-term	The cost of solar power generation will decrease to the present cost level of power generation of wind and biomass (the cost is one to two times compared to that of fossil fuel at that time). We should introduce the price policy of grid feed-in through bidding in certain areas as the experiment, and define the standard of price subsidy in accordance with the external benefit and the method of opportunity cost.
Long-term	Realize the development in scale, and participate the market competition in economy aspect directly.

5.2. Establish flexible sale price mechanism for renewable energy

The apportionment mechanism for renewable energy cost should be established by combining voluntary subscription and compulsory apportionment. The current method is we impose the electricity price addition of renewable energy at sale terminal, which is a system of government leading and costumer participating passively. In order to mobilize the enthusiasm of the major electricity consumers to support renewable energy development, the green electricity price system will be carried out. Government should provide some preferential policies such as low taxation and rewards to the residents or enterprises who subscribe to renewable energy power generation in order to inspire people have more interest to subscribe power generation of renewable energy. In 2005, Shanghai city was the first place to make an experiment on

green price. By the end of May 2006, there were 21 enterprises who subscribed to 8.45 million kWh and 1,749 households who subscribed to 0.267 million kWh in total. Although the effect of green price is unsatisfactory, it still has a breakthrough meaning as an experiment. For instance, it is beneficial to change the people's conception and promote the development of environmental protection and energy conservation.

The electricity price addition of renewable energy should be classified into scope of governmental management funds. We suggest that the electricity price addition should be imposed by the grid enterprises as compulsive government management funds, and be submitted to the treasury. National financial department will allocate it according to the development situation of renewable energy in different area.

5.3. Accelerate development of CDM project

The advantage of CDM project is the steady financial support for renewable energy power generation project. The development of renewable energy power generation is the trend in future. But due to the current character of energy structure in China, the coal is playing the leading role and at the same time, the development of renewable energy power generation projects has the several shortcomings such as the high construction cost and non-obvious short-term economic benefits. Therefore, the financing will face many problems. For example, the project of wind power generation is facing big pressure and high cost of financing. Biomass power generation is affected by season and it becomes unstable, so it is hard to finance. As for solar power generation, low profits leads to hard financing. However, the financing cost of CDM project is very low, the cash flow is steady, and the introduction of foreign capital can bring us the advanced technology. So, CDM project is a nice choice for the development of renewable energy as a financing model of low cost and stable cash flow.

Acknowledgment

This paper is supported by "the Fundamental Research Funds for the Central Universities", "the Project of Beijing Excellent Talents Training (PYZZ090424001081)", "Humanities and Social Science Foundation by the Ministry of Education of China (Grant No. 11YJA790218)" and "the Project which Jointed between Education Minister and Beijing Education Committee".

References

[1] Asian Development Bank. Biomass energy in rural China 2020; 2010.
[2] Ba Yinhu, Wang Pengcheng, Dong Xuechen. Study on the electricity price mechanism for renewable energy. Modern Business.
[3] Gu Zhihong. Research of facilitating energy saving and green electricity price of renewable energy power generation development [D] 2009, 05.
[5] Li Caihua, Luo Xin, Zhang Lizi. Assumption of perfecting the electricity price for renewable energy. Price Theory & Practice 2007, 05.
[6] Li Shujie, Peng Suying. The electricity price policy of promoting energy conservation and development of renewable energy. Macroeconomic Management 2007, 03.
[7] Luo Xin, Zhang Lizi, Li Caihua. The electricity price mechanism for renewable energy and market research. Prices Monthly 2006, 07.
[8] Luo Xin, Zhang Lizi, Li Caihua, Guo Yifei. Analysis of wind power market under the electricity price institutions of renewable energy. Price Monthly 2007, 05.
[12] State Electricity Regulatory Commission. Regulation report on renewable energy purchase and power tariff policy implementation. China Hydropower & Electrification 2009.

Further reading

[4] Huang Shaozhong. The electricity price of renewable energy: policy and perfection. China Power Enterprise Management 2009, 11.
[9] Formulate reasonable electricity price policy to push the rapid development of renewable energy industry. Vol. 27, No. 10 Oct. 2005.
[10] Sun Zhenqing, Zhang Xiliang, Zhao Zhenjun. Issues on long-term protective tariff on renewable energy power generation. Renewable Energy 2005;1 (Total 119).
[11] Sun Zhenqing, Zhao Xiusheng. Case study for long-term protective institution of electricity price of renewable energy power generation in China. Acta Energiae Solaris Sinica 2006;27.